UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/603,147	06/23/2000	John T. Moore	M122-1443	3541

21567 7590 10/16/2003

WELLS ST. JOHN P.S.
601 W. FIRST AVENUE, SUITE 1300
SPOKANE, WA 99201

EXAMINER	
KIELIN, ERIK J	
ART UNIT	**PAPER NUMBER**
2813	

DATE MAILED: 10/16/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/603,147	MOORE ET AL.	
	Examiner	Art Unit	
	Erik Kielin	2813	

-- Th MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 August 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *76,81,97 and 98* is/are pending in the application.

4a) Of the above claim(s) *none* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *76,81,97 and 98* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

1. In view of the Appeal Brief filed on 25 August 2003, PROSECUTION IS HEREBY REOPENED. New grounds of rejection are set forth below.

To avoid abandonment of the application, appellant must exercise one of the following two options:

(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) request reinstatement of the appeal.

If reinstatement of the appeal is requested, such request must be accompanied by a supplemental appeal brief, but no new amendments, affidavits (37 CFR 1.130, 1.131 or 1.132) or other evidence are permitted. See 37 CFR 1.193(b)(2).

Claim Objections

2. Claim 81 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Independent claim 76 indicates that the sidewall material "*consists essentially of* silicon, oxygen, and from about 2% to about 20% carbon by weight." Dependent claim 81 indicates that the material "*comprises* silicon carbide." Accordingly, claim 81 broadens the material of the sidewall spacers beyond claim 76 by use of open-ended language.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 76, 81, 97, and 98 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admitted prior art (**AAPA**) in view of US 6,136,700 (**McAnally** et al.) and US 6,054,379 (**Yau** et al.).

Regarding independent claim 76, **AAPA** clearly discloses each of the features of the DRAM including a semiconductor substrate **12**, the three nodes **14**, **16**, **18** in gated electrical connection via wordlines **20**, **22** with sidewalls **28**, **30** (i.e. the wordlines are the conductive gates controlling the connection between the capacitors and the storage nodes); capacitor constructions **36**, **38** formed in the openings of and directly against the insulating layer **34** --which may be BPSG as further limited by instant claim 98-- and directly against the substrate **12**; bit line contact **46**; the etch stop **32** formed over, along, and proximate the wordlines and extending along and against a portion of the storage node (first electrode **40**). Each capacitor construction comprises a storage node (first electrode) **40** formed of conductively doped polysilicon (specification, p. 4, lines 16-18), dielectric **42**, and second electrode **44**. (See Prior Art Figures 1-4 and specification, section entitled, Background of Invention" -- especially pp. 5-8. Compare especially **AAPA** prior art Fig. 1 with non-prior art Fig. 7.)

The **AAPA** is silent to (1) the sidewall spacer material consisting essentially of a material having carbon, silicon, and oxygen and (2) the insulating layer being in contact with at least one of the carbon-containing sidewall spacers.

Regarding (1), **McAnally** teaches forming either or both the sidewall spacers **108** and etch stop **110** from the aforementioned composition containing carbon, silicon, and oxygen and can comprise silicon carbide --as further limited by instant claim 81-- to improve etch selectivity specifically for etching a storage node contact. Regarding (2) **McAnally** teaches that the etch stop layer **110** may be omitted because the sidewall spacers are made of the etch-resistant carbon-containing material and that this beneficially eliminates an etch step. (See Abstract; col. 3, lines 37-40; claim 3; col. 5, lines 10-43; col. 6, lines 25-31.)

It would have been obvious to one of ordinary skill at the time of the invention was made to use the sidewall spacer material of **McAnally** for the sidewall spacer material of **AAPA** for the reasons indicated in **McAnally** --especially to protect to the gate structure from being damaged during etching of the opening for the storage node contact. It would be obvious to have the insulative material **34** of **AAPA** directly contacting one of the sidewall spacers (i.e. omitting the etch stop layer **32**) to beneficially reduce the number of etch steps, as taught to be beneficial in **McAnally**.

Then the only difference is that neither **AAPA** nor **McAnally** indicates the amount of carbon in the sidewall spacers to be "from about 2% to about 20% carbon."

Yau teaches an etch stop material containing silicon, oxygen and from 1% to 50% carbon with 20% being preferred, which reads on "from about 2% to about 20% carbon" (Abstract, col. 4, lines 18-63). The etch stop material provides good selectivity relative to non-carbon

containing dielectric materials such as silicon dioxide or doped silicon oxide (col. 12, lines 1-38; Figs. 8A to 8F).

It would have been obvious to one of ordinary skill at the time of the invention to use the silicon, oxygen and 20% carbon content taught by **Yau** in the sidewall spacers of **AAPA** in view of **McAnally** because (1) **McAnally** suggests using a carbon-rich oxide as the etchstop/sidewall material and (2) **Yau** teaches a specific "carbon-rich oxide" containing silicon, oxygen, and "preferably about 20%" carbon by weight, which also gives good etch selectivity between the etch stop and the same overlying insulating material in each of **AAPA**, **McAnally**, and **Yau**. Note that the overlying insulating material in each of **AAPA** (item 34 in prior art Fig. 1), **McAnally** (item 112 in Figs. 1C-1E) and Yau (items 510 and 518 in Figs. 8E-8F) is, *inter alia*, a silicon dioxide or doped silicon dioxide. (See instant application p. 4, lines 8-9; McAnally col. 3, lines 52-59; and Yau col. 12, lines 12-13.) Accordingly, a reasonable expectation of success exists for the use of the carbon-doped silicon oxide material in the **AAPA** structure, since each of **McAnally** and **Yau** teaches that the carbon-containing material is an etch stop relative to silicon oxide and doped silicon oxide. Moreover, **McAnally** teaches the carbon-doped silicon oxide material is used as an etch stop for exactly the same purpose as that disclosed in the instant specification: to provide protection to the gate electrodes during etching of the node contact in the silicon oxide interlayer dielectric. **McAnally** is silent to the quantity of carbon, such that one of ordinary skill would be especially motivated to apply the teaching of **Yau,** since **Yau** teaches the appropriate amount of carbon (about 20% by weight) to gain etch selectivity relative to the overlying silicon oxide.

Further in this regard, although the carbon quantity is not exactly as claimed by Applicant, overlapping ranges are *prima facie* obvious in the absence of unexpected results. (See MPEP 2144.05.) In this case, there exists no unexpected result. Rather the result indicated in the instant specification is exactly the same as in each of **McAnally** and **Yau**: etch selectivity is provided by adding carbon to the silicon dioxide etch stop and/or the sidewall spacers which enables protection of the gate electrode during etching of the node contact.

Regarding claim 97, **AAPA** and **McAnally** do not teach that the sidewall spacers have a thickness of less than about 500 Å. However, **McAnally** further indicates that a success of the invention is that "the invention allows for maximizing the area on the substrate that is in contact with a self-aligned contact" and that "the large contact area reduces the contact resistance and therefore increases the performance of the semiconductor device." (See col. 2, lines 18-27.) And more pertinently, **McAnally** states, "Thus the use of an appropriate material for stopping layer **110** may allow the use of thinner films for the insulating film **106** and *the sidewall [spacers]* **108**, which increases contact area and improves planarity." (See col. 4, lines 42-45; Italicized emphasis added.) **McAnally** explicitly suggests minimizing the width of the sidewall spacers **108** which directly affect the contact area. The greater etch selective materials enable narrower or thinner sidewall spacers and etch stops because, as indicated in **McAnally**, the etch selectivity is greater between the carbon-containing materials and the non-carbon-containing materials. Accordingly, it would have been obvious for one of ordinary skill in the art, at the time of the invention to choose a sidewall spacer width of less than 500 Å in order to increase the contact area in accord with the **McAnally** invention and to thereby provide greater contact area in the

AAPA contact. (Compare this with the instant specification paragraphs bridging pages 14-15 and 22-23, which conveys virtually the same concept as McAnally.)

Furthermore, the selection of the sidewall spacer thickness is *prima facie* obvious because it is a matter of determining optimum process condition by routine experimentation with a single variable, i.e. the thickness of the sidewall spacers within the implicit suggestion of **McAnally** which indicates that carbon-containing sidewall spacers and etch stops are more etch selective, which implicitly indicates that said materials can perform the same etch-prevention function with less of the material. (See MPEP 2144.05.)

Furthermore, as devices shrink, so do the dimensions of the features of each device according to Moore's Law. Accordingly, the choice of sidewall spacer thickness is merely a matter of routine optimization, as indicated above. Applicant has not recognized an advantage not already known in the art regarding the thickness of the spacers. In other words, one of ordinary skill would not continue to use sidewall spacers of a thickness used in a 1-μm rule, for devices in a 0.18-μm rule; instead, the size of all of the features, particularly the sidewall spacers, would be necessarily be scaled down.

It would have been obvious to one of ordinary skill at the time of the invention to choose the sidewall spacer thickness in the **AAPA** to be less than 500 Å, depending upon the size of the opening between the wordlines, in order to optimize the sidewalls relative to the device being formed, and for the reasons just indicated above.

Response to Arguments

5. Applicant's arguments with respect to claims 76, 81, 97, and 98 have been considered but are moot in view of the new ground(s) of rejection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Erik Kielin
Primary Examiner
October 1, 2003